CLAIMS

What is claimed is:

1. A ligament fixation implant comprising:

a frame comprising a plurality of elongated members situated in longitudinal alignment with an axis;

a plurality of rings connected to each of the elongated members and aligned transversely to the elongated members.

2. The ligament fixation implant of claim 1 wherein the elongated members have a distal end and a proximal end and further comprising a radially outwardly extending projection secured to the proximal end of each of the elongated members.

3. The ligament fixation implant of claim 2 wherein the distal end of each of the elongated members is tapered.

4. The ligament fixation implant of claim 2 wherein each of the plurality of rings is connected to each of the plurality of elongated members such that the rings are held together in a fixed longitudinal spacing along the axis.

5. The ligament fixation implant of claim 4 wherein the rings are each spaced a predetermined respective distance from the proximal end of the elongated members.

6. The ligament fixation implant of claim 1 wherein each of the plurality of rings is aligned in a plane perpendicular to the elongated members.

7. The ligament fixation implant of claim 1 wherein each of the plurality of rings forms a closed loop.

8. The ligament fixation implant of claim 1 further comprising an interference screw having a body with a proximal end, a distal end, and a longitudinal axis therebetween, a

helical thread extending radially from the screw body, the helical thread having a distal major diameter adjacent the distal end and a proximal major diameter adjacent the proximal end, the proximal major diameter being greater than the distal major diameter, the screw able to be inserted axially through the rings along with a ligament to cause the ligament to bulge radially outwardly and grip the rings.

9. The ligament fixation implant of claim 8 wherein the screw causes the ligament to bulge more proximally than distally.

10. The ligament fixation implant of claim 8 wherein the screw thread distal major diameter is sufficiently small to pass through the rings and the screw thread proximal major diameter is too large to pass through the rings.

11. The ligament fixation implant of claim 8 wherein the elongated members have a distal end and a proximal end and the rings are each spaced a predetermined respective distance from the proximal end of the elongated members, the screw thread proximal major diameter being substantially contained in the space between the proximal end of the elongated members and the rings when the screw is fully inserted.

12. The ligament fixation implant of claim 11 wherein the screw further causes the proximal ends of the elongated members to deflect outwardly to tightly engage the bone.

13. A graft retaining system for retaining a graft in a bone, the bone containing a bone tunnel having a longitudinal axis, a tunnel opening, an internal tunnel wall, and an external bone surface adjacent the tunnel opening, the system comprising:

means for engaging the bone including a first member having a first portion that engages the bone in positive axially fixed relationship and a second portion

including a plurality of longitudinally spaced closed rings positionable within the bone tunnel around the graft; and

means for engaging the graft including a second member insertable through the rings adjacent the graft to press the graft radially outwardly such that it bulges over the rings to fix the graft axially within the bone tunnel.

14. The graft retaining system of claim 13 further comprising a removable bracing member engageable with the plurality of members to temporarily brace them against radially inward deflection.

15. The graft retaining system of claim 13 wherein the means for engaging the bone comprises a plurality of hook members extending outwardly from the tunnel opening to engage the external bone surface adjacent the tunnel opening.

16. The graft retaining system of claim 13 wherein the means for engaging the bone comprises a radially projecting annular ring.

17. The graft retaining system of claim 13 wherein the means for engaging the bone comprises a surface engageable with a shoulder formed in a countersink within the bone tunnel.

18. The graft retaining system of claim 13 wherein the first member further comprises a third portion that engages the bone to prevent rotation of the first member about the tunnel axis.

19. The graft retaining system of claim 13 wherein the first member further comprises at least one longitudinal rib connecting the plurality of rings, the at least one rib extending radially outwardly beyond the rings a predetermined distance, the at least one rib being receivable by a channel formed longitudinally in the internal tunnel wall.

20. The graft retaining system of claim 13 wherein the second member comprises a screw having a helical thread with a helix angle and the closed rings are angled to form a helix with a helix angle corresponding to the screw helix angle.

21. The graft retaining system of claim 13 wherein the means for engaging the bone comprises a plurality of generally parallel elongated members having a proximal end and a distal end, a plurality of rings being connected to each of the elongated members and aligned transversely to the elongated members, the means for engaging the graft comprising an interference screw having a body with a proximal end, a distal end, and a longitudinal axis therebetween, a helical thread extending radially from the screw body such that the screw may be inserted axially through the rings along with a ligament to cause the ligament to bulge radially outwardly and grip the rings.

22. The graft retaining system of claim 21 wherein the helical thread has a distal major diameter adjacent the distal end and a proximal major diameter adjacent the proximal end, the proximal major diameter being greater than the distal major diameter, the rings each being spaced a predetermined respective distance from the proximal end of the elongated members, the screw thread proximal major diameter being substantially contained in the space between the proximal end of the elongated members and the rings when the screw is fully inserted.

23. The graft retaining system of claim 21 wherein the screw further causes the proximal ends of the elongated members to deflect outwardly to tightly engage the bone.

24. A graft fixation implant for securing a graft in a bone tunnel, the implant comprising:

a cage having at least one elongated member situated in longitudinal alignment with an axis

at least one ring connected to the at least one elongated member; and

an interference screw sized to be inserted axially through the ring to compress the graft ligament against the cage and the bone tunnel wall.

25. A graft fixation implant for securing a graft in a bone tunnel having an inner tunnel wall, the implant comprising:

a cage body having a lumen for receiving a portion of the graft;

antirotation means for positively engaging the inner tunnel wall to resist rotation of the cage about the bone tunnel axis; and

means for compressing the graft radially outwardly into engagement with the cage body and inner tunnel wall.

26. An instrument for inserting a graft cage having a generally tubular cage body having an axis, a proximal end and a distal end, the cage having a fixed predetermined length, the cage body comprising a plurality of elongated, diametrically opposed, parallel rib members and at least one annular body member secured to the rib members, the annular body member having an axis coincident with the cage axis, the instrument comprising:

means for engaging the rib members to brace them against radial inward deflection; and

means for imparting an axial insertion force on the cage body.

27. The instrument of claim 26 wherein the means for engaging the rib members comprises a tubular sleeve having a sleeve wall with an inner surface, an outer surface, a proximal end, and a distal end, the sleeve wall including opposed longitudinal slots formed from the distal end toward the proximal end for receiving the rib members, each rib member

further comprising a circumferential lip that engages the outer surface of the sleeve wall to prevent the rib member from deflecting radially inwardly.

28. The instrument of claim 27 further comprising a removable obturator that fits through the tubular sleeve and through the cage body, the obturator having a smooth distal tip to ease insertion of the cage into the bone tunnel.

29. The instrument of claim 28 wherein the obturator includes a longitudinal bore to permit it to be inserted over a guide wire.

30. An instrument for preparing a bone tunnel to receive a graft cage having a generally tubular cage body having an axis, a proximal end and a distal end, the cage having a fixed predetermined length, the cage body comprising a plurality of elongated, diametrically opposed, parallel rib members and at least one annular body member secured to the rib members, the annular body member having an axis coincident with the cage axis, the instrument comprising:

a shaft having a proximal end, a distal leading end, and an enlarged portion proximal to the distal leading end, the enlarged portion forming an enlarged counterbore in the bone tunnel upon being inserted into the bone tunnel, the counterbore formed being sized to receive the cage body.

31. The instrument of claim 30 further comprising rails projecting radially from the enlarged portion to form opposed channels adjacent the counterbore to receive the rib members.

32. A method for retaining a graft in a bone, the method comprising:

forming a tunnel in the bone;

inserting a first member into the bone tunnel, the first member having a plurality of longitudinally spaced closed rings;

inserting the graft through the rings; and

inserting a second member adjacent the graft to press the graft radially outwardly to cause it to bulge around the rings to fix the graft axially within the bone.

33. The method of claim 32 further comprising:

forming a counter bore adjacent the tunnel entrance prior to inserting the first member.

34. The method of claim 32 further comprising:

providing the first member with a plurality of longitudinal ribs connecting the rings, the ribs extending radially beyond the rings, the ribs being generally parallel to the tunnel axis;

forming channels inside the tunnel along the tunnel wall parallel to the tunnel axis;

inserting the first member with the ribs engaging the channels to resist rotation of the first member about the tunnel axis.

35. The method of claim 32 further comprising:

providing the first member with at least one ring axially aligned with the tunnel and a plurality of ribs connected to the at least one ring, the ribs being generally parallel to the tunnel axis;

engaging the ribs with an instrument to prevent radial inward deflection of the ribs prior to the second member being inserted.

36. The method of claim 35 further comprising:

inserting an obturator through the at least one ring to ease insertion of the first member, the obturator including a rounded leading end; and

withdrawing the obturator prior to inserting the graft.

37. A method of securing a graft ligament in a bone tunnel comprising:

providing a cage comprising at least one elongated member situated in longitudinal alignment with an axis, at least one ring connected to the at least one elongated member;

forming a bone tunnel;

inserting the cage into the bone tunnel;

inserting an end of a graft axially through the ring;

providing an interference screw; and

inserting the interference screw axially through the ring to compress the graft ligament against the ligament fixation implant and the bone tunnel wall.

38. A method of securing a graft ligament in a bone tunnel having an inner tunnel wall, the method comprising:

providing a cage including antirotation means for positively engaging the inner tunnel wall to resist rotation of the cage about the bone tunnel axis;

forming a bone tunnel;

inserting the cage into the bone tunnel with the antirotation means engaging the inner tunnel wall;

inserting an end of a graft axially through the cage;

providing an interference screw; and

inserting the interference screw axially through the ring means to compress the graft ligament against the cage and the bone tunnel wall.

39. The method of claim 38 wherein the antirotation means comprises a plurality of elongated members extending radially outwardly to engage a plurality of longitudinal channels formed along the inner tunnel wall, the method further comprising:

forming a plurality of longitudinal channels along the inner tunnel wall; and

engaging the plurality of elongated members with the plurality of longitudinal channels.